

Map Unit Properties Table

Age	Map Unit (Symbol)	Unit Description	Erosion Resistance	Suitability for Development	Hazards	Paleontologic Resources	Cultural Resources	Mineral Occurrence	Habitat	Recreation	Geologic Significance
QUATERNARY (RECENT)	Disturbed ground and artificial fill (Qdgf)	Mix of boulders, rip rap, unsorted fill, and other materials associated with disturbed lands used for road construction, urban development, water management facilities, and other purposes.	Low	Used for development; avoid highly permeable, undercut and/or poorly compacted areas.	May fail if present on a steep slope and/or if water saturated.	None documented	May contain modern artifacts and information about historic development	None documented	None documented	Suitable for most recreation unless present on a steep slope.	Older deposits may contain a record of historic anthropogenic developments.
QUATERNARY (HOLOCENE)	Alluvium (Qa)	Broad deposits flanking active stream channels of sand, gravel, clay, and silt layers.	Very low	Avoid stream edge/riparian areas for heavy development, especially for wastewater treatment due to proximity to water and high permeability.	Associated with stream banks and riparian zone areas; may be unstable if exposed on a slope or water saturated.	Modern remains	May contain artifacts and/or settlement sites along major waterways	None documented	Riparian zones and burrow habitat	Suitable for some trail development	Records modern stream valley development throughout Quaternary.
QUATERNARY (HOLOCENE & PLEISTOCENE)	Terrace deposits, low level (Qt); Colluvium (Qc); Debris (Qd); Landslide (Ql)	Qt: concentrated near stream confluences; reworked alluvial sand, gravel, silt, clay, larger colluvium clasts. Qc: often fills broad hollows in meadow areas; contains relatively unsorted fine-grained fragments in layers of variable thickness; Qd: is a heterogeneous mix of fine and coarse fragments, often found filling hillslope depressions; Ql: jumbled mix of large rock fragments in an unsorted sand, gravel, clay, and silt matrix.	Very low	Avoid most terrace and colluvium deposits for heavy development due to instability of slopes and high permeability.	Associated with stream edge slopes, and mass movements deposited by gravity, water, and debris-flow processes.	May contain modern remains, plant fragments, pollen from trees, shrubs, and herbs, and petrified logs(?)	May contain artifacts and/or settlement sites along major waterways	None documented	Forms upland areas supporting larger trees and bushes; greater soil development along waterways.	Avoid areas near slopes due to likelihood of failure.	Terrace units record the changes in channel morphology of local streams;
QUATERNARY (PLEISTOCENE)	Low- level fluvial and estuarine deposits (Qte); Upper- level fluvial and estuarine deposits (Qfe)	Qte: sand, gravel, and peat interbedded with thin silt and clay beds with scattered pebbles and cobbles; incised into younger fluvial and estuarine deposits; Qfe: contains modern swamp deposits overlying bedrock in Washington, D.C., area.	Low	Avoid for most development due to presence of modern swamp areas, high permeability and proximity to water.	May be unstable on slopes especially if undercut.	Wood fragments, limonite filled root zones; may contain silicified bald cypress logs and mammal fossils	May contain artifacts	None documented	Units underlie much of metro Washington, D.C., area.	Avoid heavy development due to presence of modern swamp deposits.	May contain some record of the evolution of land use in the Washington area.
TERTIARY & QUATERNARY (PLEISTOCENE)	Terrace deposits, upper level (QTt)	Sand and gravel in beds as much as 50 ft thick; local incision into underlying Cretaceous age units is possible.	Low	Avoid most terrace deposits for heavy development due to instability of slopes and high permeability.	Thickness and presence along upper valley areas may increase likelihood of slope instability and mass wasting.	Plant fragments and recent remains possible	May contain artifacts	None documented	Upper deposits support hardwood forests.	Suitable for most recreation unless high slopes are present.	Unit records changes in climate and tectonic uplift with incision history.
TERTIARY	Terrace deposits (Tt); Highest level upland terrace deposits (Ttu)	Units have layered mixtures of gravel and sand, with large pebbles and cobbles of vein quartz and quartzite; terraces occur at various elevations above sea level including 360 ft, 310 ft, 400 ft, and 370 ft.	Low	Suitable for light development; avoid waste water treatment facility development due to high permeability.	Heterogeneous nature of units may render them unstable on slopes; prone to gulleying, especially at higher levels; layered nature of units may render sheet flow a possible hazard.	Plant fragments and recent remains possible	May contain artifacts	None documented	Units support upland forest areas along waterways.	Suitable for light recreation unless highly gullied and/or undercut on a slope.	Record movement of waterways in the Tertiary; climatic and tectonic record.

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TERTIARY (PLIOCENE)	Yorktown Formation and Bacons Castle Formation, undivided (Tyb)	Unit contains quartz and feldspar sands and gravels in planar and cross-bedded thin to thick, fine- to coarse- grained, poorly to well- sorted beds; some clay and silt occur as matrix material in yellowish- to orange- gray outcrops.	Low	High permeability; may be unsuitable for waste treatment facility; heterogeneity of layers may render them unstable along slopes, especially if undercut.	Mass movements are likely when water saturated.	<i>Ophiomorpha nodosa</i> present in beds; estuarine remains	Fossil shells used for early trade.	None documented	High level may provide burrowing habitat.	Good for most recreation unless undercut, present as cliffs along waterways, or water saturated.	Unit records Pliocene depositional environments, correlative throughout the region.
TERTIARY (MIDDLE MIocene)	Calvert Formation (Tc)	Tc: mostly fine to very fine quartzose sand with some variable silt and clay layers; thick bedded with mappable sand- silt- clay sequences; in outcrop unit appears grayish- olive, light gray to white, pinkish- gray and pale yellowish- orange.	Moderately low	Suitable for most development; avoid pebbly layers for waste treatment facilities; avoid expandable clay-rich layers for road and trail development.	Massive bedding may be prone to large block slides when unit is undercut along rivers and gullies.	Diatoms (including <i>Raphoneis diamantella</i>), fish, shark teeth, scales, shell fragments, lignitized wood, marine vertebrates, silicoflagellates, dinocysts; remains of oak, elm, holly, bean leaves, sumac, supplejack, blueberry, and fetterbrush	Kaolinite may have been used for painting and dyes.	Kaolinite, quartzite and crystalline etched pebbles, phosphate pebbles	Caps higher hills supporting ridge top forests.	Good for most recreation unless clay- rich layers predominate	Records Miocene age marine depositional environments.
TERTIARY (EOCENE)	Nanjemoy Formation (Tn)	Yellowish- brown (weathered) to dark olive gray, greenish- gray, and olive black glauconitic quartz sand; fine to coarse, clayey and silty, micaceous and shelly layers with interbeds of silty and sandy clay.	Low	Suitable for most forms of development.	Glauconite cemented sand may slide off slopes in large blocks or sheets, especially if water saturated.	Bioturbated; contains shell fragments, mollusks including <i>Venericardia poapacoensis</i> , <i>Venericardia ascia</i> , <i>Macrocallista sumimpressa</i> , <i>Corbula aldrichi</i> , <i>Lucina dartoni</i> , <i>Lunatia</i> sp., <i>Cadulus</i> sp.; also clam shells, pollen, dinoflagellates, foraminifers, ostracodes	Iron sulfide concretions may have provided fire making materials.	Iron sulfide nodules; glauconite	None documented	Suitable for most forms of recreation unless very clay- rich layers are present.	Records Eocene marine depositional environments.
TERTIARY (EOCENE & PALEOCENE)	Marlboro Clay (Tm)	A conspicuous layer of gray clay and yellow silt rich clay with lenses of silt locally present; thickness 0 to 40 ft; present over a wide area.	Low	Avoid for most development as unit is slippery on slopes and acts as a local aquitard.	Possible mass wasting on slopes when water saturated.	Lignite coal; small mollusks, foraminifera, calcareous nanoplankton, dinoflagellates	Clay may have been used to make pots, paint.	Clay	None documented	Slippery trail base; avoid for most recreation development.	Widespread marker bed; conspicuous in regional stratigraphic column.
TERTIARY (PALEOCENE)	Aquia Formation (Ta)	Massive micaceous glauconitic quartz sand, thick bedded; fine to medium sands interlayered with some clay and silt rich-beds, as well as lenses of sandy and shelly limestone; fresh surfaces are dark olive gray and greenish- black, weathers to yellowish- gray to orange; supports important freshwater aquifer.	Low	Suitable for most forms of development unless highly permeable layers are present, or significant heterogeneity exists locally which may cause unit to be unstable.	Glauconite cemented sand may slide off slopes in large blocks or sheets, especially if water saturated or undercut by poorly consolidated shelly layer.	Mollusks (<i>Cucullaea gigantea</i> , <i>Ostrea alepidota</i> , <i>Crassatellites</i> sp., <i>Dosimopsis</i> sp), ophiomorpha- type burrows, gastropod <i>Turritella mortoni</i> , bivalves <i>Ostrea sinuosa</i> , <i>Crassatellites alaeformis</i> , and <i>Cucullaea</i> sp., foraminifera, dinocysts, nannofossils, pollen, burrows, molds and casts of pelecypods, taeniodont molar fragment (see paleontological inventory for NCN)	None documented	Ilmenite is locally abundant; glauconite.	Poor cementation may provide burrowing habitat.	Suitable for most forms of recreation unless very clay- rich layers are present.	Records marine to terrestrial depositional environment during the Tertiary-Quaternary transition (Thanetian age).

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CRETACEOUS & TERTIARY (PALEOCENE)	Brightseat Formation and Monmouth Formation, undivided (TKb)	Unit contains deposits of greenish-gray clayey sand in the upper beds and dark gray, micaceous sand in the lower beds; at the base of the unit is a thin gravel layer.	Moderately low	Clay and mica rich layers render unit unstable locally; avoid undercut slopes.	Prone to slumping, creep, and sliding as semi-cohesive blocks.	Fossiliferous.	None documented	None documented	Poor cementation may provide burrowing habitat.	Suitable for most forms of recreation unless clay-rich layers are present.	Records transition between Tertiary and Cretaceous Periods (K-T boundary?)
CRETACEOUS	Monmouth Formation (Km); Severn Formation (Ks)	<u>Km</u> : basal gravels of vein-quartz pebbles below interlayered sand, clayey sand, and silty sand; <u>Ks</u> : mixed marine deposits including sands, silts, and clays.	Moderate	Variations in bedding, sediment type, and degree of cementation may render unit unstable on slopes.	Sand and gravel units above clay-rich (less resistant) layers may pose mass wasting hazard along slopes and waterways.	Marine fossils, shell marl; 100 species of mollusks including pelecypods bivalves, gastropods, cephalopods (nautiloid and ammonoid), ostracodes (at least 37 species); shark, ray, and sawfish teeth; fish bones; otoliths, pliosaur and mosasaur, crocodile teeth; sea turtle, hadrosaur, ornithomimid scraps (see paleontological inventory for NCN)	None documented	Vein quartz pebbles	Poor cementation may provide burrowing habitat; resistant units may form ledges on slopes attractive to birds.	Suitable for most forms of recreation unless clay-rich layers are present or unit outcrops as bluffs along major waterways.	Unit records abundant life in the Cretaceous seaway
CRETACEOUS	Potomac Formation, undivided (Kp); Potomac Formation, Clay-dominated lithofacies (Kpc); Potomac Formation, Sand-dominated lithofacies (Kps)	Units contain alluvial and channel deposits of massive, mottled, silty clay with minor sand and thin beds of tan, clayey sand; local interbeds include unconsolidated coarse feldspar and quartz sand, quartz gravel, montmorillonite and illite, clayey sand, and sandy silt with lignite.	Moderate, depending on how well lithified	Variations in bedding, sediment, and degree of cementation may render unit unstable on slopes; otherwise, generally suitable for most development.	Clay-rich massive bedded layers may spall in large blocks when unit is exposed on slope; susceptible to slumps and slides.	Plant stems, leaf and stem impressions, silicified tree trunks, dinosaur fossils, pollen, "Mount Vernon flora" (collection of 40 species of ferns, conifers, and flowering plants), <i>Menispermites</i> , fossil bones of " <i>Capitalsaurus</i> "; Arundel clay contains theropod, sauropod, ornithopod, akylosaurian, and ceratosaurian dinosaur remains, fish, crocodiles, turtles, bird remains, 25 species of angiosperm (See paleontological inventory for NCN)	May preserve ancient campsites and relics.	Silicified coniferous tree trunks, vein quartz, quartzite, and metamorphic rock pebbles and cobbles; lignite	Supports eastern hardwood forests throughout region.	Suitable for most forms of recreation unless present as bluffs along major waterways.	Widespread unit records Cretaceous environment along Atlantic Coast; dominant unit of coastal plain sediments; Barremian?, Aptian, and Albian age pollen and leaves dated.
DEVONIAN	Lamprophyre dike (Dl)	Linear igneous intrusions of lamprophyre with dark mafic minerals present as clasts and matrix material.	Moderately high, depending on degree of alteration	Suitable for most development.	Rockfall hazard if undercut or exposed on a slope.	None	None documented	Biotite, hornblende, pyroxene, and feldspar	Weathers to Mg, Fe, and Ca(?) rich soils.	Suitable for most recreation unless highly fractured.	Unit has an argon biotite cooling age of ~360 Ma.
ORDOVICIAN	Pegmatite (Op)	Non-foliated coarse-grained assemblage of muscovite, microcline, albite, and quartz.	High to moderately high in areas of high fracture density or alteration.	Suitable for most development unless radioactive minerals present; avoid heavily fractured areas.	Forms steep slopes along waterways and poses mass wasting hazard along trails and in undercut areas.	None	Large crystals may have provided trade material.	Muscovite, microperthitic microcline, albite, and quartz crystals	Weathers to poor soils.	Suitable for most recreation unless highly fractured.	Pegmatites may contain unusual minerals.

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ORDOVICIAN	Clarendon Granite (Oc); Kensington Tonalite (Ok)	Oc: leucocratic biotite- muscovite monzogranite, well- foliated. Ok: light gray granodiorite gneiss in a well- foliated 1.8 mile- wide shear zone with augen and coarse porphyroblasts of microcline.	Moderately high to high depending on degree of alteration and brittle deformation	Avoid areas of intense preferential weathering (along foliation). Suitable for most development unless highly weathered and/or fractured.	Associated with steep slopes along waterways; mass wasting hazard along trails and in undercut areas.	None	Interesting minerals may have provided trade material.	Muscovite, microcline augen, garnet, biotite, vein quartz	None documented	Suitable for most recreation unless highly weathered along foliation.	Ok has a U- Pb SHRIMP (Super High Resolution Ion Micropulse) age of 463 ± 8 Ma.
ORDOVICIAN	Dalecarlia Intrusive Suite: Biotite monzogranite and lesser granodiorite (Odm), muscovite trondhjemite (Odt)	Odm: biotite monzogranite; Odt: muscovite trondhjemite, light gray to white in outcrop with a fine- grained sugary texture.	High	High mica contents of some units may prove unstable for foundations.	Exposed on steep slopes near the parkway and may be susceptible to block falls.	None	None documented	Sugary trondhjemite; building stone	Unit supports wide range of forest types.	Suitable for most recreation unless highly weathered.	Odm has U- Pb SHRIMP age of 478 ± 6 Ma; Odt has zircon U- Pb SHRIMP age of 478 ± 6 Ma.
ORDOVICIAN	Georgetown Intrusive Suite: Biotite- hornblende tonalite (Ogh); quartz gabbro (Ogg); biotite tonalite (Ogb); garnetiferous biotite- hornblende tonalite (Ogr); soapstone and talc schist (Qgs); ultramafic rocks (Ogu); pyroxenite (Ogp)	Intrusive suite contains various tonalites rich in biotite, garnet (locally), and hornblende, with ultramafic- mafic rocks including quartz gabbro (rich in olivine and quartz), talc schists, and soapstone; xenolith- rich areas contain ultramafic, mafic, and assorted metasedimentary rocks.	Moderate to moderately high depending on degree of alteration	Heterogeneous nature of unit as well as heavily altered areas may render the unit unsuitable for heavy development projects. Avoid highly fractured areas.	Outcrops locally as bluffs; susceptible to mass wasting including landslides and block falls	None	Interesting minerals may have provided trade material.	Soapstone, quartz gabbro, talc, garnet	Weathers to Fe- and Mg- rich soils.	Suitable for most recreation unless highly altered, cleaved, and/or fractured.	Ogh has a zircon U- Pb SHRIMP age of 472 ± 4 Ma.
ORDOVICIAN	Bear Island Granodiorite (Ob); Granite (Ogl)	Ob: leucocratic muscovite- biotite granodiorite with coarse- grained pegmatitic textures, locally in sheets, sills, and dikes of moderate size; Ogl: small dikes, sheets, and other irregular bodies; well- foliated, fine- to coarse- grained muscovite monzogranite and granodiorite; may be coeval with Og and Ok.	High	Avoid areas of intense preferential weathering (along foliation and between heterogeneous lenses); suitable for most development unless highly weathered and/or fractured.	Rockfall hazard if undercut or exposed on a slope.	None	None documented	Quartz, albite, and microcline in pegmatite; biotite and hornblende	Wide range of forest types.	None documented	Record wide range of tectonic conditions and intrusions during the Ordovician.
CAMBRIAN	Sykesville Formation: Diamictite (Cs); Diamictite tectonite (Cst); Metagraywacke and schist (Csg); Chlorite- sericite phyllonite (Csp)	A conspicuous sedimentary mélange with diamictite, tectonite, metagraywacke, schist, and phyllonite; dominated by gray matrix of quartz and feldspar; distinctive round and tear- shaped cobbles of white and clear quartz. Other inclusions are: boulders of dark gray phyllonite, light gray migmatite and metagraywacke, greenish- black mafic and ultramafic rocks, metagabbro, and light gray metafelsite and plagiogranite; entire mélange was squeezed into a massive gneiss wedge.	Moderately high	Unit is fine for most development unless heavily altered and/or fractured.	Rockfall hazard when unit is exposed on slope especially if slope and dominant cleavage direction are parallel.	Possible trace fossils	Widespread unit underlies Theodore Roosevelt island, Turkey Run Park, and American Legion Bridge.	Lustrous phyllite; clear quartz cobbles	Wide range of forest types.	Suitable for most recreation unless highly altered, cleaved, and/or fractured.	Records deformation along Rock Creek shear zone; records depositional setting in a collapsing basin.
CAMBRIAN	Laurel Formation (Cl)	A sedimentary mélange with a matrix of quartz and feldspar that supports fragments, elongate cobbles, and bodies of meta- arenite and muscovite- biotite schist. Some local partial melting is recorded as migmatites and leucosomes.	Moderately high	Altered schist layers as well as brittlely deformed layers render these units locally unstable for heavy development.	Susceptible to block falls, landslides, slumping, and slope creep for altered, deformed, and fine grained units.	Possible trace fossils	None documented	Migmatites	Wide range of urban habitats.	Altered and deformed areas should be avoided for most forms of recreation.	Records accretionary environment during Appalachian orogeny.

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PALEOZOIC	Vein quartz bodies (PZq)	Unit is present as lenses, veins, and irregular bodies of massive, white and clear, vein quartz of various ages; jointed and locally foliated from tectonic stress; often present as resistant loose boulders.	Very high	Suitable for most development; unit is very localized; avoid highly fractured areas.	Resistant to weathering but may pose a rockfall hazard if cobbles are large enough.	None	None documented	White quartz	None documented	Suitable for most recreation.	Ubiquitous quartz- rich veins may hold clues to tectonic history of area; useful marker beds.
CAMBRIAN AND (OR) PROTEROZOIC	Diamictite (CZd); Mather Gorge Formation: Schist (CZms); Metagraywacke (CZmg); Migmatite (CZmm); Migmatitic metagraywacke (CZmng); Migmatitic schist (CZmms); Migmatitic phyllonite (CZmmp); sheared migmatitic schist and migmatitic phyllonite (CZmss)	CZd contains conglomerate in a mixed quartz and feldspar matrix. Pebbles include milky quartz and other clasts derived from phyllites, schists, etc. The Mather Gorge Formation contains a suite of metasedimentary rocks including schist interbedded with thin metagraywacke and meta- arenite. These rocks originated as impure sandstones and shales. Original features include graded beds, soft- sediment slump folds, and clastic dikes. Muscovite- rich schist was intruded by thin quartz veins and many layers have been metamorphosed to staurolite- kyanite grade with local migmatization in a narrow belt.	Moderately high	Heterogeneous nature of units may prove unstable for heavy foundations and development; high degree of foliation and cleavage also weakens the unit.	Metagraywackes are associated with the formation of waterfalls and rapids throughout the area and may pose rockfall hazards.	None	None documented	Epidote, staurolite, kyanite, migmatite, lustrous muscovite schist	Units support wide range of habitat types.	Unit is suitable for most recreation unless highly altered, cleaved, and/or fractured.	Units record the metamorphism and deformation associated with accretion onto the North American continent during early collision events.
CAMBRIAN AND PROTEROZOIC	Metavolcanic and meta- igneous rocks of uncertain origin;; ultramafic rocks (CZu); metavolcanic and meta- igneous rocks of uncertain origin; amphibolite (CZa); metavolcanic and meta- igneous rocks of uncertain origin; metagabbro and metapyroxenite (CZg); metavolcanic and meta- igneous rocks of uncertain origin; soapstone, talc schist, actinolite (CZt); Metavolcanic and meta-igneous rocks of uncertain origin (CZmvmi)	The metavolcanic and meta- igneous rocks of uncertain origin contain several differentiated units. All the units have been metamorphosed and occur as irregular bodies within the Laurel Formation (Cl). Ultramafic rocks include dark greenish- black metagabbro and metapyroxenite; these have been altered to soapstone, talc schist, serpentinite, and dark green and black, medium and coarse grained amphibolite. Some actinolite schist is present locally as greenish- gray and fine to coarse grained foliated layers.	Moderate to high depending on degree of alteration and/or deformation	High degree of alteration associated with some units may prove unstable for heavy development; avoid fractured areas for septic systems and wastewater treatment areas.	Cobbles of soapstone and talc schist may be susceptible to rockfall locally.	None	Units underlie much of the Washington, D.C., area, especially in the National Zoo.	Pyroxene, hornblende, plagioclase, epidote, soapstone, talc, actinolite	Unit develops into Fe, Mg, and Ca rich soils that support a variety of hardwood forest types.	Unit is suitable for most recreation unless highly altered, cleaved, and/or fractured.	Rocks record extensive metamorphism and hydrothermal alteration associated with deep burial and tectonic collision events.